SPEED CONTROLLER HAVING SEVERAL OPERATING MODES

Background Information

The present invention relates to a speed controller for motor vehicles according to the species defined in the main claim. One example of a speed controller of this species is known from DE 199 58 120 A1, which, on the one hand, is operable in a so-called ACC mode (adaptive cruise control), and on the other hand in a so-called stop and go mode.

In the ACC mode, the speed of the vehicle is regulated to a desired speed selected by the driver, provided the roadway ahead of his own vehicle is clear. A distance sensor, such as a radar sensor, permits detecting vehicles traveling ahead on his own traffic lane and other obstacles, and adjusting speed, if necessary, in such a way that the immediately preceding vehicle is followed at an appropriate safety distance. The ACC mode is provided, in general, for travel on express highways or well developed highways having flowing traffic, and also for traffic situations characterized by relatively low dynamics and relatively large vehicle separations. Under these conditions, a long-range tracking radar, having comparatively low depth resolution, is sufficient for recording the traffic surroundings.
The relative speed of the tracked object is directly measurable with the aid of the Doppler effect. In order to avoid frequent faulty reactions of the system, only moving radar objects are generally considered as relevant target objects, since, in general, it is not to be expected that there are standing objects on the roadway. However, in traffic situations having greater dynamics, such as in slow-

moving traffic or stop and go traffic, or even in city traffic, standing targets should also be included in the evaluation. Moreover, in this case, because of the generally shorter vehicle separations, a more detailed detection and evaluation of the traffic situation is also desirable. The ACC mode is unsuitable for these traffic situations and is therefore only able to be activated when the speed of one's own vehicle is above a certain limiting speed, such as above 30 km/h.

On the other hand, the stop and go mode is provided for the lower speed range and affords functions that are not available in the ACC mode, in particular the function of braking one's own vehicle to a standstill, such as when driving to a traffic jam. Under certain circumstances an automatic restart-up is then also possible, when the preceding vehicle is also set in motion again. These conditions are satisfied, for example, when one's own vehicle has stood still for a relatively short time, and when the target object followed up to the present, that is, the preceding vehicle, has constantly remained in the tracking range of the distance sensor. On the other hand, under other conditions, it may be expedient to deactivate the system altogether, or simply to have it emit a start-up prompt to the driver when the preceding vehicle starts up, and to leave the last decision up to him. For an expanded functionality in the stop and go mode, not only is the detection of standing targets required, but in general an additional close-range sensor system is also desirable, such as in the form of a video system having electronic image evaluation, a close-range radar or a light-optical distance sensor for the close range including the left and right roadway edges, so that suddenly appearing obstacles may also be detected in time. This more complex detection and evaluation of the traffic environment, which is required, or at least desirable for the stop and go mode, in the case of higher speeds could, however, lead to faulty reactions or to an overload of the system. For this reason, the stop and go mode is only able to be activated at speeds up to an upper limiting speed, such as up to 40 km/h.

In the overlapping zone between the speed ranges for ACC and Stop and Go, that is, in the example assumed, between 30 and 40 km/h, both modes are able to be activated and the selection of the mode is left to the driver. Special mode selection keys are provided in the known system for selecting the operating mode, using which, the driver is able to activate either the ACC mode or the Stop & Go mode. The active participation of the driver in the selection of the operating mode is regarded as making sense, because in this way it is made clear to the driver in which mode the system just happens to be, and which functions of the speed controller are available. Thus it is particularly prevented, if the preceding vehicle suddenly stops, that the driver mistakenly assumes that the speed controller is in the Stop & Go mode, and relies on the speed controller automatically to brake to a standstill. However, some drivers feel that the necessity of having to select the operating modes themselves is an impairment of their operating convenience, and that the command keys needed for this purpose make the operating system more involved and requiring more explanation.

Summary of the Invention

By contrast, the speed controller according to the present invention, having the characterizing features of Claim 1, as long as appropriate consideration is given to the safety aspects, has the advantage of greater operating convenience and greater clarity and greater plausibility of the operating system.

The speed controller according to the present invention is in a position to interpret commands, by which the driver increases and decreases the desired speed, at the same time as commands for changing the operating mode, provided the remaining conditions for this are also appropriate for this purpose. Consequently, special command keys for the selection of the operating mode may be omitted. But still, the driver remains a participant in the selection of the mode, by way of the input of the desired speed, so that the transparency of the system remains observable to the driver. A mode change,

which is connected not to a restriction, but rather to a broadening of the scope of the functions of the speed controller, does not require any increased attention of the driver, and can therefore also be introduced automatically, without participation of the driver. If, on the other hand, the mode change has the effect that a safety-relevant function, which was available up until then, is no longer available, then the driver should be made aware of this, so that he does not mistakenly rely on the function that is no longer there. However, if the driver actively selects a speed which is clearly outside the speed range permitted for the mode up to that point, then it will be clear to the driver that the mode up to that point cannot be maintained, and therefore the selection of this desired speed can only be judged as a sign that the driver consciously wants to assume a greater responsibility, so that the input of an additional command to change the operating mode is unnecessary.

Advantageous further developments and improvements of the speed controller stated in the main claim are achieved using the features described in the dependent claims.

In order to raise the transparency, it is preferred if the driver is made aware by a suitable signal, such as an optical or an acoustical signal, that a mode change has taken place, and in which mode the speed controller currently is to be found.

In one preferred specific embodiment, the speed controller has only two main operating modes, namely the ACC mode and a mode designated here as "Stop & Roll". The concept "Stop & Roll" refers to a mode which lies somewhere between the ACC mode and the Stop & Go mode, discussed at the beginning, with respect to the sensor system required and the complexity in the evaluation of the traffic environment. In the Stop & Roll mode, as in the Stop & Go mode, automatic braking of the vehicle to a standstill is possible, but, because of the restricted sensor technology, this mode is not intended for highly dynamic traffic situations such as occur, for instance, in city traffic.

In order to avoid frequent mode changes, it is expedient if the changeover as a function of the desired speed selected by the driver takes place having a certain hysteresis. Thereby it may especially be achieved that the speed controller remains in the current mode if the desired speed selected lies within the overlap range in which both operating modes are permitted.Since the actual speed of the vehicle does not always agree with the desired speed set by the driver, the actual speed of the vehicle should also be drawn upon as a criterion for a mode change. For reasons of clarity, one should here regard as the actual speed the speed indicated to the driver on the tachometer. It is advantageous if the criterion "actual speed" is also handled flexibly, in the sense that short-lived undershooting of the speed at which the switchover into the Stop & Roll mode should actually take place, are tolerated with the aid of a timer. Thus the driver has the possibility of inputting a higher desired speed prospectively in the Stop & Roll operation, and thereby implicitly giving the command to change into ACC mode, when he notices that the traffic jam ahead of him is breaking up. Normally, the vehicle will then accelerate within a short time to a speed at which ACC operation is permissible. Only when the minimum speed for ACC within a time span such as 5 seconds is not reached, perhaps because the preceding vehicle is going too slowly, does the system automatically relapse into Stop & Roll mode again.

If the desired speed that is set is greater than the limiting speed for ACC, but the actual speed of the vehicle falls below this value on account of the traffic, and remains below this value for a certain time, a switchover automatically takes place into the Stop & Roll mode. In this case, the desired speed is limited automatically to the greatest value permissible for Stop & Roll. Then, to return into the ACC mode, an action of the driver is therefore again required, namely the input of a higher desired speed.

In both main operation modes an override by operating the gas pedal is possible, just as with usual speed controllers of this sort. The acceleration request input by the driver on the

gas pedal then has precedence over the lesser setpoint acceleration calculated by the speed controller. Even in these override situations a change between the two main modes is possible, but a change from Stop & Roll to ACC only on condition that the driver actively raises the desired speed. Otherwise the speed controller is deactivated if the actual speed reaches a threshold value, at which the functions of the Stop & Roll operation can no longer be maintained.

When the speed controller has been deactivated, it can be reactivated by the input of a desired speed. Preferably, there then follows the decision whether the ACC mode or the Stop & Roll mode shall be activated, as a function of whether the actual speed lies above or below the limiting speed for ACC.

In one special specific embodiment, the decision regarding a mode change and/or regarding the activating or deactivating of an operating mode can also be a function of whether certain conditions with respect to the recording of the traffic environment are satisfied, so that an ever greater operating safety is achieved.

Brief Description of the Drawing

Two exemplary embodiments of the present invention are represented in the drawings, and are explained in detail in the description below. The figures show:

Figure 1 a block diagram of the speed controller;

Figure 2 a diagram of speed ranges at which the various operating modes of the speed controller are able to be activated; and

Figure 3 a diagram for explaining the transitions between the various main operating modes and conditions of the speed controller.

Detailed Description of the Exemplary Embodiments

In Figure 1 a speed controller 10 is shown as a block diagram by which, in a manner that is known but not described in

greater detail here, the speed of a motor vehicle is controlled to a desired speed selected by the driver. To operate speed controller 10, a multifunctional lever is usually provided on the steering wheel, which fulfills the functions of several function keys: a "+" key 12 to activate the control and for raising the desired speed V_{set}, for example, in steps of 10 km/h, a "-" key 14 for activating the controller and for reducing desired speed V_{set}, an OFF key 16 for deactivating the controller and a resume key 18 for renewed activation of the controller, while assuming the desired speed prevailing before the last deactivation. In response to the first activation of the controller with the aid of the "+" key or "-" key, the actual speed V of the vehicle rounded up or down to the next full 10 is assumed as the desired speed V_{set} of the vehicle, just as it is displayed on the tachometer. When resume key 18 is pressed, without a desired speed having been stored, for the determination of the desired speed, one rounds up or down to the whole ten that is closest to the actual speed.

Speed controller 10 takes up signals from a long range distance sensor 20, such as a long range radar and from a short range sensor system 22, which is formed, for example, by a short range radar, a light-optical distance sensor system, a video system and the like. When the sensor system detects a preceding vehicle traveling in one's own lane, if necessary, the speed of the vehicle is reduced to below the desired speed set, so that the preceding vehicle may be followed at an appropriate safety distance, for instance, at a selectable time gap of 1 to 2 seconds. In one operating mode, known as ACC (adaptive cruise control), the spacing regulation takes place exclusively with the aid of signals of long range distance sensor 20, which has a locating range such as 10 to 200 m. This operating mode is provided for travel on express highways and well constructed highways at flowing traffic, that is, for traffic situations in which, in general, people travel at relatively high speeds. In addition, speed controller 10 has a controller mode which is designated as Stop & Roll and is provided for traffic situations having high

traffic density and correspondingly low speed, such as for slow-moving traffic or traffic jam operation on express highways and highways. In this mode, signals of the short range sensor system 22 are also evaluated, so that shorter vehicle spacing may be detected more accurately. Whereas in the ACC mode only movable objects are considered as relevant target objects, in the Stop & Roll mode other standing targets also have to be evaluated which are detected by long range distance sensor 20 or by close range sensor system 22. In addition, close range sensor system 22 also has a greater locating angular range, so that objects can also be detected which in the close range are located on neighboring lanes or at the edge of the roadway. Hereby the system is put into a position of reacting in time to suddenly appearing obstacles, such as vehicles suddenly swinging in from the side lane.

The Stop & Roll mode has at least one controlling function which is not available in the ACC mode, in particular, a stop function by which the vehicle may be automatically braked to a standstill upon the approach to a standing obstacle.

The control functions in the two operating modes ACC and Stop & Roll are known as such, and are therefore not described here in more detail.

Speed controller 10 has a decision unit 24 which, in dependence upon the respective traffic situation and with the collaboration of the driver, decides in which operating mode the speed controller is working. The criteria for these decisions will be explained in more detail below. Speed controller 24 also includes one or more integrated timers 26, which are needed within the scope of decision processes.

If decision unit 24 has selected the ACC mode, this is indicated to the driver by the lighting up of an indicator light 28 on the dashboard. Correspondingly, an indicator light 30 incicates the operating mode Stop & Roll. In addition, a loudspeaker 32 is provided, by the use of which the driver is made aware of a change in the operating mode by an acoustical

signal, or may even be warned of certain system states or traffic situations.

In Figure 2 the speed ranges are shown, in which the operating modes ACC and Stop & Roll (S&R) are able to be activated. Basically, the ACC mode is able to be activated when the actual speed V of the vehicle is greater than a limiting speed V_s. The S&R mode is able to be activated when the actual speed of the vehicle is lower than a speed $V_s + h_1$. The speed range between V_s and $V_s + h_1$ is consequently a hysteresis range, in which either the ACC mode or the S&R mode may be active. As an example, let us assume that the limiting speed V_s is 30 km/h and that the hysteresis interval h_1 is 5 km/h.

Figure 3 shows the various operating states of the speed controller as well as the most important transitions between them. The active operating states divide up into the main operating modes ACC and S&R.

In a state 32 "readiness", the sensor systems and the evaluation and control algorithms of speed controller 10 are active, so that the traffic events can be followed, but no control commands are given to the driving or the braking system of the vehicle, so that the control over the vehicle remains with the driver. So long as the driver does not actively input a command to activate the speed controller, the speed controller remains in the readiness state, as is symbolized by an arrow T1.

The driver is able to activate the speed controller by operating "+" key 12, "-" key 14 or resume key 18. Decision unit 24 then decides, in the light of the present actual speed V, whether the speed controller is changing into state 34 "ACC active" or state 36 "S&R active". If actual speed V is greater than limiting speed V_s, then, upon the activation of each of the three keys 12, 14, 18, transition into state 34 "ACC active" corresponding to arrow T2 in Figure 3 takes place. If, on the other hand, actual speed V is less than or equal to V_s, transition into state 36 "S&R active" takes place according to arrow T3. In this case, the desired speed is set to V_s,

provided that the desired speed set by operating keys 12, 14 and 18 was greater than this value. As a result, the ACC mode is able to be activated only when the speed of the vehicle is at least 30 km/h. Otherwise, the controller goes into S&R mode, and the vehicle speed is limited to the range of 1 to 30 km/h, that is, to the range in which a flawless functioning of the S&R mode is ensured.

In state 36, the driver now has two possibilities of accelerating the vehicle to above 30 km/h and of going over into ACC mode. On the one hand, the driver is able to select a greater desired speed, by single or multiple operation of "+" key 12. As soon as the new desired speed V_{set} is greater than $V_s + h_1$ in the example assumed, that is, at least 40 km/h, decision unit 24 brings about a transition into state 34, as shown by arrow T4. As an alternative to that, the driver may operate the gas pedal in state 36, and thus override the S&R control function, so that, according to arrow T5, the controller goes over into state 38, "override S&R". After the vehicle has been accelerated to the desired speed, and the driver lets up the gas pedal, the controller returns to state 36 "S&R active", according to arrow T6. If he then selects a desired speed V_{set}, by operating "+" key 12 or "-" key 14, which is greater than $V_s + h_1$, the controller goes to state 34 via arrow T4. The driver is also able optionally to select a desired speed V_{set} that is greater than $V_s + h_1$, even while he holds down the gas pedal and thus is in state 38, by operating the "+" key or the "-" key. Then, as soon as the actual speed V is greater than $V_s + h_1$, there is a transition to state 40 "override ACC", according to arrow T7. If the driver now lets up the gas pedal, according to arrow T8, transition takes place into state 34 "ACC active". The speed of the vehicle is then controlled to the newly selected desired speed V_{set}, and the actual speed will also remain above 30 km/h, since the speed was at least 35 km/h when the gas pedal was let up.

As may be seen from the above description, the driver has to operate at least once "+" key 12 or "-" key 14 (or resume key 18), in order to reach the ACC mode (state 34) from the S&R mode (state 36). As a result, this mode change does not take

place without the active participation of the driver, and consequently not against the will of the driver.

The driver, of course, is able to override state 34 "ACC active" by operating the gas pedal, so that he temporarily reaches state 40, according to arrow T9.

Arrow T10 in Figure 3 describes the regular transition from ACC mode into S&R mode, or, more accurately, the transition from state 34 into state 36. This transition is possible when one of the following conditions is satisfied:

a) The desired speed V_{set} is lower than limiting speed V_s, and in addition, the actual speed V is lower than $V_s + h_1$. This corresponds to the situation in which the driver selects a low desired speed by operating "-" key 14. The vehicle will then slow down, and the transition into S&R mode takes place as soon as the speed range provided for this mode is reached, according to Figure 2.

b) Actual speed V decreases from a value above limiting speed V_s to a value below this limiting speed. That is typically the case when, upon driving up to the end of a traffic congestion, long-range distance sensor 20 detects a slow or stopped vehicle in its own lane, and accordingly throttles the speed. The transition into the S&R mode then takes place as soon as the speed region, permissible for the ACC mode according to Figure 2, is left. In this case the desired speed V_{set} is automatically set to V_s in order to ensure that the speed controller, when the congestion has lifted, does not return again by itself to the ACC mode, but only when the driver actively raises the desired speed again, corresponding to a transition according to arrow T4. The transition from ACC to S&R may also take place optionally only when V_s is undershot for the duration of a certain time interval. This achieves a certain tolerance against noise in the speed signal.

c) desired speed V_{set} is raised by driver command to a value which is greater than $V_s + h_1$, and, in addition, after the expiration of a time span measured by timer 26, actual speed V is still lower than V_s. This corresponds to the situation in

which the driver, according to arrow T4, wishes to change into ACC mode, but limiting speed V_s that is at least required for this mode cannot be achieved within an appropriate time span such as 5 seconds, for instance, because there is an even slower preceding vehicle in front of the driver's vehicle. In this case, the speed controller automatically returns to state 36 again, after the expiration of the time span mentioned. In order to reach state 34, the driver must then once again input a command to increase the desired speed as soon as the lane ahead of him is free.

In exceptional cases, a transition from state 40 "override ACC" into state 38 "override S&R" is also possible, as indicated by arrow T11. This transition takes place when the driver lowers the desired speed to a value below V_s, and the actual speed V decreases to below V_s in spite of the operation of the gas pedal, i.e. when the driver does decrease the desired speed, but then, by operating the gas pedal, assures that the vehicle decelerates slower than is specified by the speed controller.

From state 36 "S&R active" a transition into a state 42 "S&R stop" is also possible, as symbolized by arrow T12. In state 42, speed controller 10 effects the automatic braking of the vehicle to a standstill. Subsequently, the speed controller, according to arrow T13, goes over into one of several start-up states which determine whether the renewed starting up of the vehicle is controlled by speed controller 10, if traffic conditions permit it, or when the driver confirms a corresponding start-up request, or whether the start-up procedure is controlled by the driver himself. Details of these start-up procedures are described in DE 199 58 520 A1.

The transition into state 42 according to arrow T12 takes place when, in state 36, the speed of the vehicle (the determining factor here is not the indicated but the actually measured speed) has decreased to below a threshold value such as 4 km/h, e.g. when approaching a standing obstacle. Since this function "braking to a standstill" is only available in the S&R mode, in the speed controller described here, the

transition from the S&R mode into the ACC mode, and thus the renouncement of this function, is only permitted when the driver inputs a corresponding command by active operation of one of keys 12, 14 or 18.

In each of the active states, speed controller 10 can be inactivated if one of several predefined events occurs. The most important of these events are the operation of OFF key 16 by the driver and the operation of the brake pedal by the driver. In Figure 3, deactivation from state 36 "S&R active" is only shown by an arrow T14. The speed controller then runs through a transition state 44, in which the control commands given out to the drive and/or brake system are gradually driven back, so that a jerk-free transition and a correspondingly great riding comfort is achieved. From transition state 44, the speed controller then goes into state 32 "readiness" again, according to arrow T15. The desired speed prevailing before the deactivation remains stored, however, and is called up again when the driver operates resume key 18 in state 32. An exception may optionally be provided for the case in which the stored desired speed is greater than limiting speed V_s, and at operation of resume key 18 the actual speed of the vehicle is less than V_s. In that case there is then a transition into S&R mode, and the desired speed is set to V_s, as was described in connection with arrow T3. This takes into account the possibility that the driver, after a protracted inactive phase of the speed controller, has forgotten that he was last in ACC mode, in which the function "brake to stillstand" is not available.

As was described in connection with arrow T7, a transition from state 38 "override S&R" into state 40 "override ACC" takes place only when the driver increases the desired speed which was prevalent up to now in the S&R mode. If the desired speed remains unchanged, and the driver accelerates by operating the gas pedal, it can therefore happen that the speed becomes greater than the speed permissible for the Stop & Roll mode. In this case the speed controller is compulsorily deactivated, as is symbolized by arrow T16. Going into detail, this deactivation takes place under condition that desired

speed V_{set} is less than or equal to V_s, and that, in addition, actual speed V is greater than a threshold value $V_s + h_2$. Here h_2 is a hysteresis parameter which may optionally be identical to h_1.

For the sake of completeness, in Figure 3, still two further states 46 "ACC braking" and 48 "S&R braking" are shown, in which the speed controller can only act upon the braking system of the vehicle, but not upon the drive system. These states are reached when the parking brake is operated in the ACC mode (state 34) or in the S&R mode (state 36), or when in these modes the electronic stability program (ESP) of the vehicle detects a lane condition having low frictional connection (e.g. an icy road). A transition is in that case only possible in the direction from an ACC mode into the S&R mode, that is from state 46 into state 48, according to arrow T17, when the actual speed V is lower than V_s. From state 48 then, according to arrow T18, braking to a standstill is possible again.

Whereas in the exemplary embodiment described here it was assumed that the desired speed is only able to be changed in intervals of 10 km/h, the present invention is applicable analogously also in the case of speed controllers in which the desired speed may be changed steplessly or in smaller increments, such as at intervals of 1 km/h.

The conditions for the change between modes ACC and S&R are summarized once more in the following Table 1.

Table 1

Activation ACC

T2	V > Vs AND (+, - OR resume operated)

Activation S&R

T3	V ≤ Vs AND (+, - OR resume operated) (V_{set} is limited to V_s)

S&R after ACC

T4	$V_{set} > V_s + h_1$
T7	$V_{set} > V_s + h_1$ AND $V > V_s + h_1$

ACC after S&R

T10	(V_{set} < Vs AND $V < V_s + h_1$) OR
	(V decreases below Vs) OR
	($V_{set} > V_s + h_1$ AND $V < V_s$ AND timer expired)
T11	$V_{set} < V_s$ AND $V < V_s$

Deactivation S&R

T16	$V_{set} \leq V_s$ AND $V > V_s + h_2$

For the explanation of a second exemplary embodiment of the speed controller, reference can also be made to Figure 3, since this exemplary embodiment differs from the example described before essentially only in that, for the transitions between the states shown in Figure 3 other conditions apply. For the definition of these conditions, parameters are used which are stored in decision unit 24, and which are specified as follows:

Threshold value for the switchover between ACC and S&R

V_{select} = 35 km/h

Maximum desired speed for S&R:

V_{SRset} = 30 km/h.

Minimum speed (limiting speed) for ACC:

V_{ACCmin} = 30 km/h

Threshold value for devaluating S&R when overriding

V_{SRs} = 45 km/h

Maximum vehicle distance for activating S&R:

d_{SRon} = 30 m

Maximum vehicle distance for deactivating S&R:

d_{SRoff} = 50 m

Waiting time when target object is lost:

T_1 = 5 s

The conditions for activating and deactivating the operating modes ACC and A&R, and for the change of mode are apparent from the following Table 2.

<u>Table 2</u>

Activation ACC

T2	$V > V_{select}$ AND (+ OR - operated OR (resume operated AND $V_{set(slt)} > V_s$))

Activation S&R

T3	$V = V_{select}$ AND (+, - OR resume operated) AND $d < d_{SRon}$ (is limited to V_{SRset})

S&R after ACC

T4	$V > V_{select}$ AND $V_{set} > V_{select}$
T7	$V_{SRs} \geq V > V_{select}$ AND $V_{set} > V_{select}$

ACC after S&R

T10	V decreases to under V_{ACCmin}

Deactivation S&R

T14	t > Tl OR d > d_{SRoff} OR (V > V_{SRs} AND (none of keys +, - OR resume is operated))
T16	V > V_{SRs} AND (none of keys +, - OR resume is operated)

The ACC mode is activated (arrow T2) when actual speed V is greater than limiting speed V_{select}, and, in addition, the driver operates "+" key 12 or the "-" key. The operation of resume key 18, by which the last stored desired speed is reestablished, only effects the activation of the ACC mode if the last stored desired speed $V_{set(alt)}$ is greater than V_{select}.

Mode S&R is activated (arrow T3) when actual speed V is at most equal to V_{select}, and the driver operates a key 12, 14 or 18. However, in addition, in this exemplary embodiment the condition still has to be satisfied that the sensor system has detected a target object, and the distance of the target object is at most equal to d_{SRon}, that is, at most 30 m. As a result, the Stop & Roll can only be activated when a target object, such as a vehicle traveling ahead, is available at a distance that is not too great so that the actions of the speed controller are determined by the behavior of the preceding vehicle. By this the danger is avoided that faulty reactions come about when a relevant target object has not been recognized by the distance sensor system.

Upon activation of the S&R mode, desired speed V_{set} is limited in this example to speed V_{SRset} (30 km/h).

A change from state 36 "S&R active" into state 34 "ACC active" according to arrow T4, occurs in this exemplary embodiment when actual speed V is greater than V_{select}, and, in addition, a desired speed is selected by operating one of keys 12, 14, 18, which is greater than V_{select}.

A change from state 38 "override S&R" into state 40 "override ACC" (arrow T7) takes place only when actual speed V is greater than V_{select} (35 km/h) but less than threshold value V_{SRs} (45 km/h), and, in addition, the desired speed is set to a greater value than V_{select}, by operating one of keys 12, 14, 18. As a result, in order to get into the ACC mode by operating the gas pedal, the driver has to operate one of keys 12, 14, 18 while the speed is in the interval between 35 and 45 km/h. Thereby, the driver is supposed to be made aware that he is now leaving the S&R mode, in which the function "braking to a standstill" is available. If the driver misses or deliberately omits operating one of the keys in this speed interval, the behavior of decision unit 24 depends on actual speed V. If this remains less than 45 km/h, until the driver lets go of the gas pedal, the system returns to state 36 (arrow T6). Otherwise the speed controller is deactivated (arrow T16).

The transition from state 34 "ACC active" to state 36 "S&R active" takes place automatically as soon as actual speed V decreases to below the minimum speed V_{ACCmin} for the ACC mode (arrow T10).

A transition from state 40 "override ACC" to state 38 (override S&R), corresponding to arrow T11 in the previous exemplary embodiment is not provided in this specific embodiment. If the speed of the vehicle decreases to below the minimum speed for ACC, in spite of the fact that the driver operates the pedal, such as when driving on steep hills, and the driver then lets go of the gas pedal, the transition into state 36 "S&R active" takes place via state 34 (arrows T8 and T10). On the other hand, if the driver accelerates again, so that the speed increases above V_{ACCmin} again before the driver lets go of the gas pedal, the system remains in the ACC mode. This will generally also correspond to the expectation of the driver.

When the speed controller is in state 36 "S&R active", a deactivation takes place according to arrow T14 in this specific embodiment, not only by operating off key 16, but

also automatically when one of the following conditions is fulfilled:

a) The target object followed up to now gets lost and is also not found again before time t, counted by timer 26, reaches the value T_1 (5 s).

b) The distance d of the preceding vehicle becomes greater than the parameter d_{SRoff} (50 m).

c) The current speed becomes greater than the threshold value V_{SRs} (45 km/h), for example, during steep downhill driving, and the driver does not operate any of the keys 12, 14 or 18.

By checking these conditions it is ensured that the S&R mode is active only when the speed controller is also able safely to fulfill the functions provided in this mode.